PCT / IN 04/ 00243

INTELLECTUAL PROPERTY INDIA
PATENTS / DESIGNS / TRADE MARKS / GEOGRAPHICALINDICATION

सत्यमेव जयते

Government Of India
Patent Office
Todi Estates, 3rd Floor,
Lower Parel (West)
Mumbai – 400 013

09 MAR 2005
WIPO PCT

THE PATENTS ACT, 1970

IT IS HEREBY CERTIFIED THAT, the annex is a true copy of Application and Complete Specification filed on 13/08/2003 in respect of Patent Application No.800/MUM/2003 of IMPETUS Project, OIL AND NATURAL GAS CORPORATION LIMITED, MUMBAI REGION, 634, VASUDHARA BHAVAN, BANDRA (E), MUMBAI –51, MAHARASHTRA, INDIA.

This certificate is issued under the powers vested in me under Section 147(1) of the Patents Act, 1970.

Dated this 18th day of January 2005.

(R.BHATTACHARYA)
ASST. CONTROLLER OF PATENTS & DESIGNS

PRIORITY DOCUMENT
SUBMITTED OR TRANSMITTED IN COMPLIANCE WITH RULE 17.1(a) OR (b)

FORM 1

THE PATENTS ACT, 1970
(39 OF 1970)

APPLICATION OF GRANT OF A PATENT
[See section 7]

(a) We, IMPETUS Project, OIL AND NATURAL GAS CORPORATION LIMITED., MUMBAI REGION, 634, VASUDHARA BHAVAN, BANDRA(E), MUMBAI–51, MAHARASHTRA, INDIA

(b) Indian National

2.
(a) hereby declare that We are in possession of an invention titled as - **TECHNOLOGY BREAKTHROUGH ON INTRODUCTION OF NEWLY DESIGNED EJECTORS.**

(b) that the complete specification relating to this invention is filed with this application.

(c) that there is no lawful ground of objection to the grant of a patent to us.

3. further declare that the inventors for the said invention are

(a) **MR. PADAM SINGH & MR. ASHOK VARMA**

(b) Indian Nationals.

4. That our address for service in India is as follows :

M/s M.P. MIRCHANDANI & CO.,
57, Sneh Sadan, COLABA,
MUMBAI-400 005.

5. Following declaration has been given by the inventor(s), declare that the applicant herein are our assignee or legal representative

(a) **MR. PADAM SINGH**

(b) **MR. ASHOK VARMA**

6. That to the best of our knowledge, information and belief the fact and matters stated herein are correct and that there is no lawful ground of objection to the grant of patent to us on this application.

800/MUM/2003
13/8/2003

with RQ 1252
13/8

Received Rs. 3000/- in Cash
Cheque/M.O./P.O. on 13/8/03
Vide Entry No. 4337 in the Register of Valuables, Bombay.
Cashier

...2/-

7. Following are the attachment with the application :

(a) Complete specification (3 copies)

(b) Drawings (3 copies)

(c) Statement and undertaking on FORM-3

(d) Power of authority.

(e) Fee Rs.5,000/- in cheque / bank draft bearing No._____ date _____ on _____.

We request that a patent may be granted to us for the said invention.

22/7/03

PADAM SINGH

PADAM SINGH
HEAD IMPETUS, ONGC
634, Vasudhara Bhawan,
Bandra (E), Mumbai-400 051

To
The Controller of Patents
The Patents Office
at MUMBAI.

TECHNOLOGY BREAKTHROUGH ON INTRODUCTION OF NEWLY DESIGNED EJECTORS

Padam Singh, General Manager(Production) - Head IMPETUS & Ashok Varma, General Manager(Production) – Surface Manger, NH Asset, Oil and Natural Gas Corporation Ltd., Mumbai, INDIA.

ABSTRACT

In the oil industries, some quantities of gas is getting flared due to technical reasons. It has been experienced that some of the last stage separators' gas is being flared because it can not be compressed being at lower pressure than suction pressure requirement of process gas compressors. It has also been experienced that the flared gas which includes technical flaring and gas from last stage separators is in the range of 30,000 Cub.M/day to 1,50,000 Cub.M/day on each facility. However, it depends on complexity of the facilities. This flared gas is very rich with heavy hydrocarbons which contains about 40% LPG and Naphtha. The value added products from these gases are of considerable quantity, therefore, recovery of this gas adds to high value in the profitability.

To recover flared gases, installation of Low Pressure gas compressor was the only alternative but it has been found that at some of the facilities the installation of compressors is very difficult and also very expensive. It may be noted that at some of the facilities / platforms, even there are constraints for availability of space and power. Since this problem was encountered, the solution of this problem was worked out by innovative methods on designing the Gas to Gas Ejectors and Liquid to Gas Ejectors. The flared gases which were to be recovered, were at the pressure of 0.1 kg/cm2 to 3.0 kg/ cm2. This gas required boosting upto about 7.0 kg/cm2 to push it to the suction pressure of the main process gas compressors.

The newly designed Ejectors were installed at some of the facilities and after many trials, it was possible to recover the total gas and boosting the pressure of low pressure gas from 0.1 kg/cm2 to about 7.0 kg/cm2. For these Ejectors, the high pressure gas (55 kg/cm2 to 85 kg/cm2 pressure) was used as a motive fluid for recovery fluid. Since, Ejectors recycle the High Pressure gas back to the suction of the main process compressors, the installation of Ejector for recovery of gas is only possible where surplus capacity of main process gas compressors is available. At some of the facilities where compressors capacity is not available but the surplus energy is available with the crude oil pumping system, the liquid to gas Ejectors were

designed and recovery of low pressure gas was made possible by introducing newly designed Ejectors. At some of the facilities zero gas flaring have been achieved and on other balance facilities, it is being planned.

INTRODUCTION

On introduction of newly designed Ejectors, the zero gas flaring at facilities can be made possible without installing the expensive low pressure gas compressors. The Ejectors do not have any moving part and also do not require any maintenance. The cost of Ejector system which includes total piping for motive fluid, low pressure fluid and discharge fluid, may be of maximum Rs.20 Lakhs with comparison to low pressure gas compressor costing to about Rs.1,000 Lakhs.

The Ejector does not occupy any space, it gets accommodated with the existing pipings. Therefore, at some of the facilities the zero gas flaring can be made possible only by installation of Ejectors. The newly designed Ejector are unique of its kind which can recover very low pressure gas (0.1 kg/cm2) and can boost it upto 7-10 kg/cm2. Since the flared gas at low pressure are very rich with heavy hydrocarbon, 1 Cub.M such gases would value to about Rs.12.00 instead of Rs.2.23 being the sale price of gas.

It has been experienced that on installation of Ejectors if the flared gases are recovered on offshore installation of ONGC, INDIA, it may save approximately Rs.300 Crores per annum. The plan of recovery of these gases is already in place and at some of the platform it had been achieved with zero gas flaring.

The newly designed Ejector may be identified and may be planned to be installed for many specific applications in oil industries.

The various applications in brief are as under :

a. To boost of pressure low pressure flared gas by means of gas to gas or liquid to gas Ejectors.
b. To create the vacuum in De-oxgenation Tower at water injection plants by means of surplus water falling from the height.
c. The chemical dosing pump may be replaced at water injection plant by utilising pressurised water as a motive fluid.

d. The pressure of low pressure oil production header can be boosted by installing separator, oil / water pump and Ejectors.

e. The pressure of low producer oil / gas wells can be boosted by means of high pressure oil / gas wells.

These applications of newly designed Ejector are described and explained in Figure-1,2, 3,4,5,6 & 7. These applications of newly designed Ejectors will be very much cost effective in the oil industries.

ADVANTAGES OF NEWLY DESIGNED EJECTOR

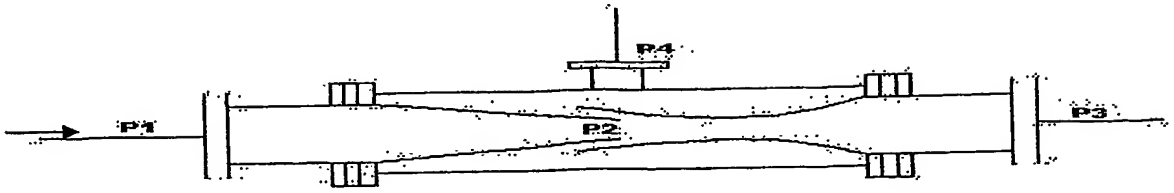
On installation of newly designed Ejector, the flared gas is possible to be recovered which will improve the profitability followings terms :

a. Flared gas recovery to value addition
b. Saving of gas is saving of energy.
c. Reduction of pollution
d. Protection of environment
e. Enhanced health and safety.

Apart of above, the newly designed Ejector have various applications which can be very much cost effective. The advantages of newly designed Ejectors can be described as under :

1. Ejector have no moving part and maintenance cost is almost nil.
2. The Ejectors being very simple and piping arrangement, it does not require any additional controls.
3. It does not require any space being a part of pipings.
4. The installation is very simple and can be fabricated at the site itself. Therefore, the lead time for supply is almost negligible.
5. The capital cost of Ejector is negligible with comparison to the compressor / pump for its application.

PRINCIPLE OF NEWLY DESIGNED EJECTOR



SKETCH

With Bernoulli Equation:

$$d\left(\frac{P}{\rho}\right) + d\left(\frac{u2}{2\,gc}\right) + d\,(hf) = 0$$

- Based on energy required for boosting low pressure fluid, the requirement of motive fluid is calculated. Thereafter, the nozzle size of Ejector is decided keeping in view the pressure of low pressure fluid to be sucked by the Ejector.
- The efficiency of Ejector is very poor (25% to 30%) but since energy is surplus or wasted due to technical reasons, its use is being made. The pressure at P2 in above sketch is brought much less than pressure at P4 by creating high velocity of fluid. Therefore the fluid at P4 is sucked by P2 fluid and increases to P3 pressure as velocity further reduces in the diffuser. Therefore the fluid at P3 is having more pressure than fluid at P4.

a. POWER CALCULATION:

i) Power required $W_G = \dfrac{\gamma \; P\,V_G}{(\gamma - 1)\,\eta_1}\left[\left(\dfrac{P_3}{P_4}\right)^{\frac{\gamma-1}{\gamma}} - 1\right]$

ii) Power utilised from high pressure gas:

$$W_P = \frac{\gamma \; P\,V_P}{(\gamma - 1)}\left[\left(\frac{P_1}{P_3}\right)^{\frac{\gamma-1}{\gamma}} - 1\right] \times \eta_2$$

W_P should be > than W_G

iii) Power utilised for high pressure liquid = W_L

$$W_L = (P_1 - P_3) \times V_L \times \eta_3$$

W_L should be > than W_G

For gas-to-gas Ejector equation (i) (ii) and for liquid-to-gas Ejector equation (i) & (iii) respectively are used for calculating the required flow of Motive fluid.

b. **NOZZLE SIZING:**

1) For sizing the nozzle and other piping etc. the *Bernoulli equation* is to be used.

$$d\left(\frac{P}{\rho}\right) + d\left(\frac{u2}{2\,gc}\right) + d(hf) = 0$$

2) The pressure at P2 is to be calculated for full flow of low pressure gas to come from P4.

3) After P2 is known, the above equation at BB-1 is to be applied for calculation of nozzle diameter of the Ejector. The diffuser length is decided by the nozzle diameter and its profile.

Legend:

γ = Compressibility factor

P = Standard abs. Pressure

V_G = Standard volumetric flow of Low Pressure Gas

η_1, η_2, η_3 = Efficiency

P_1, P_2, P_3, P_4 = Abs. Pressure

V_P = Standard volumetric flow of Motive Gas/Fluid

V_L = Standard volumetric flow of Motive Liquid/Fluid

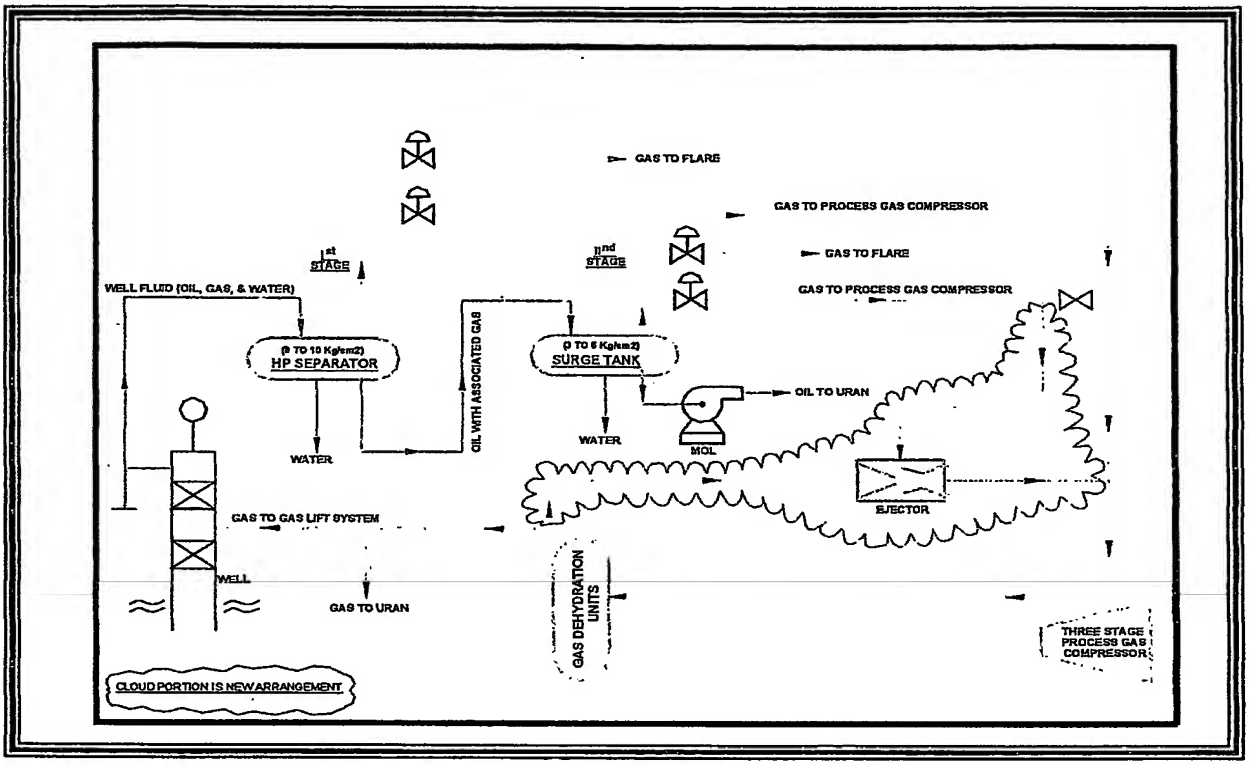
ρ = Density

(M.P. MIRCHANDANI)
Attorney for Applicant.

RECOVERY OF LOW PRESSURE GAS FROM LAST STAGE OIL / GAS SEPARATOR BY NEWLY DESIGNED EJECTOR

APPL. NO. /mum/03

Total Sheet 7
Sheet No. 1



(M.P. MIRCHANDANI.)
Attorney for Applicant

FIG - 1

NEWLY DESIGNED EJECTOR AND ITS LOCATION AT PROCESS PLATFORM

APPL.NO. 1mum/03

Total Sheet 7
Sheet No. 2

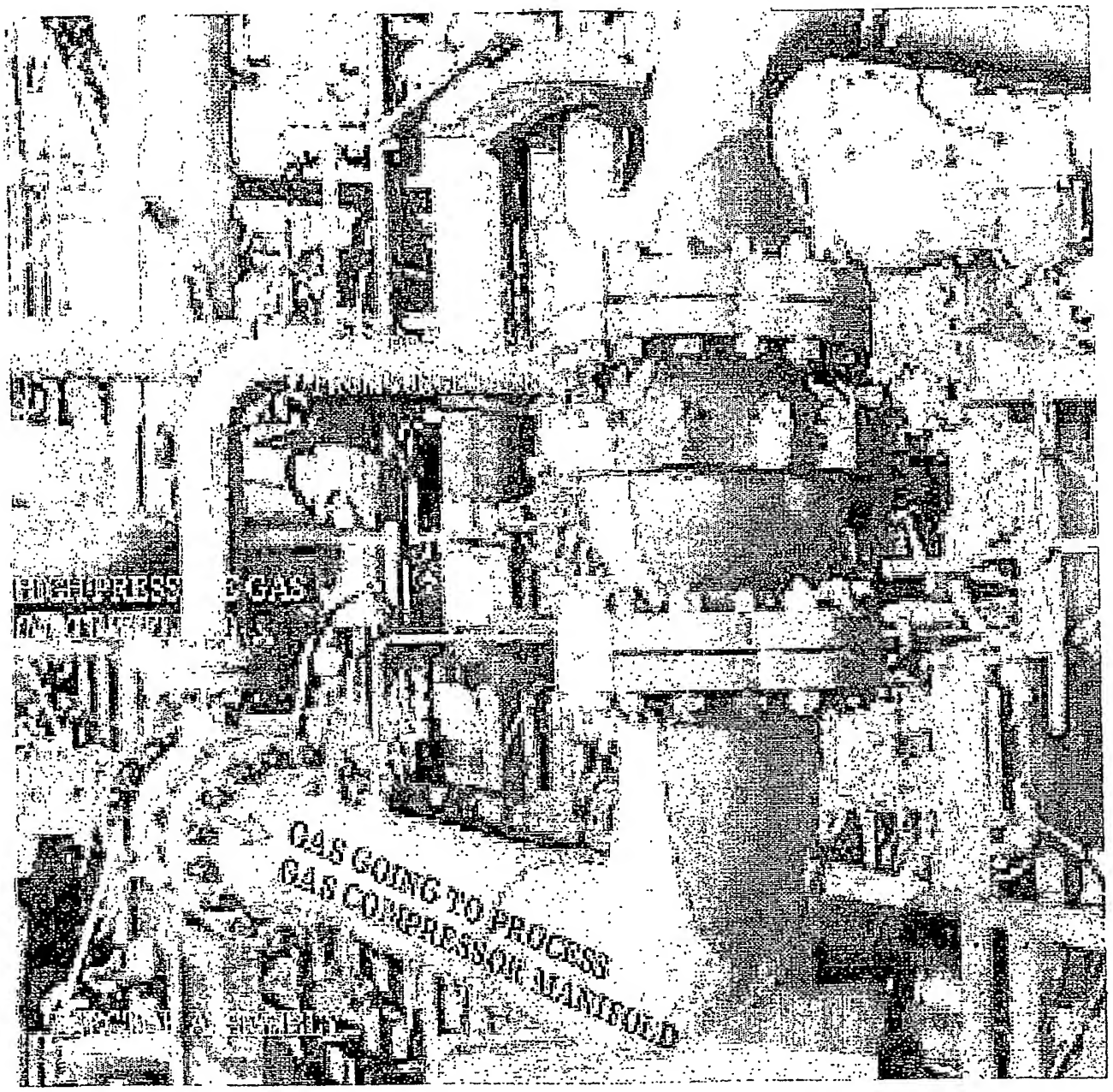


FIG - 2

(M.P.MERCHANDANI)
Attorney For Applicant

EDUCTOR FOR VACUUM IN DE-OXYGENATION TOWER

APPL. No. 1mum/03

Total Sheet 7
Sheet no. 3

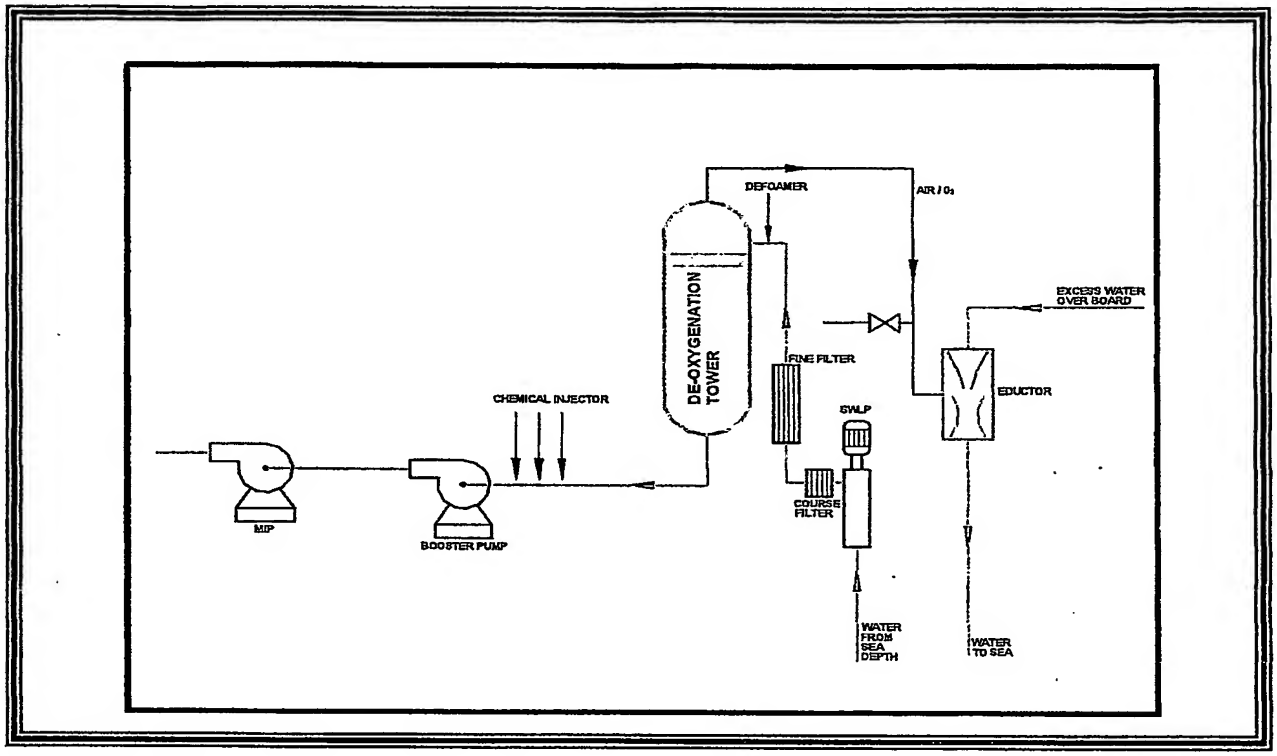


FIG - 3

(M. P. MERCHANDANE)
Attorney for Applicant

REPLACING CHEMICAL DOSING PUMP BY EJECTOR AT WATER INJECTION PLANTS IN OFFSHORE

Total Sheet 7

APPL. No. 1mvm/03 Sheet no. 4

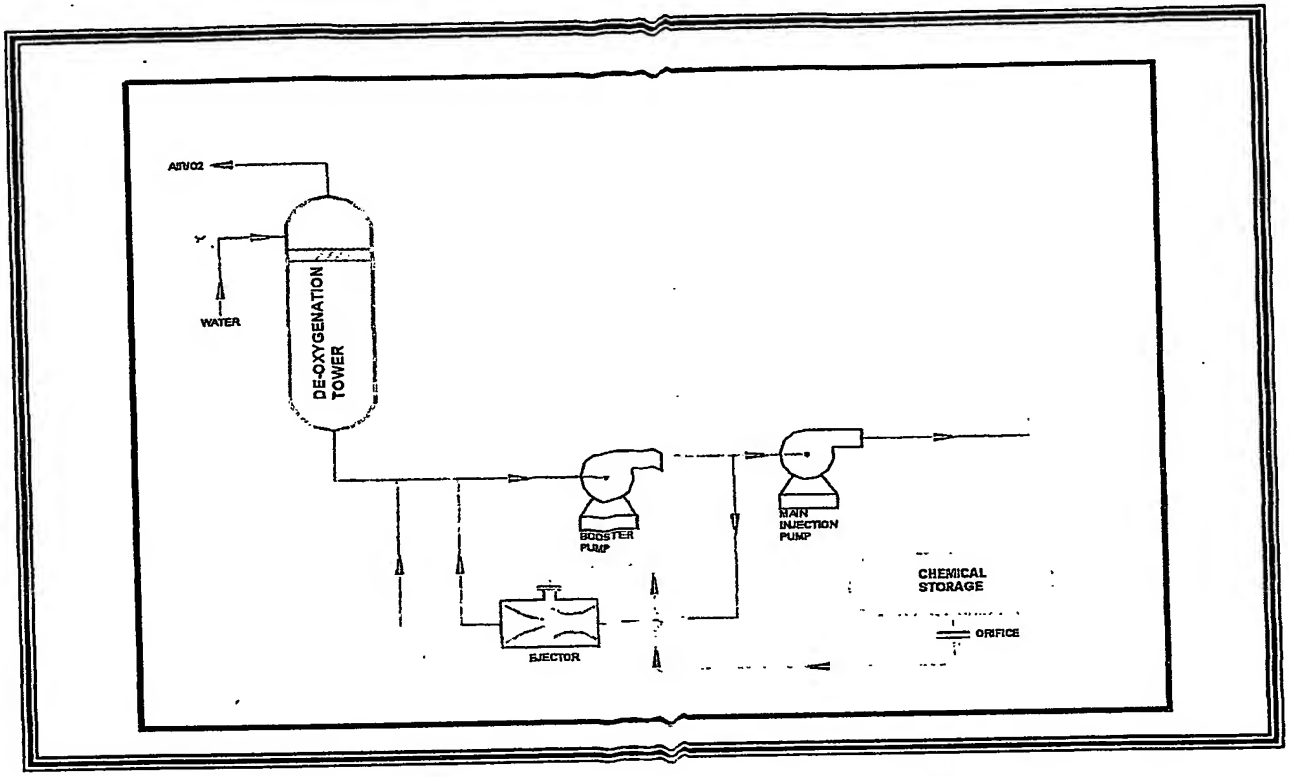


FIG - 4

(M.P.MERCHANDANI)
Attorney for Applicant

REDUCTION OF HEADER PRESSURE BY BOOSTING THROUGH NEWLY DESIGNED EJECTOR

Total Sheet. 7
Sheet no. 5

APPL. No. /mum/03

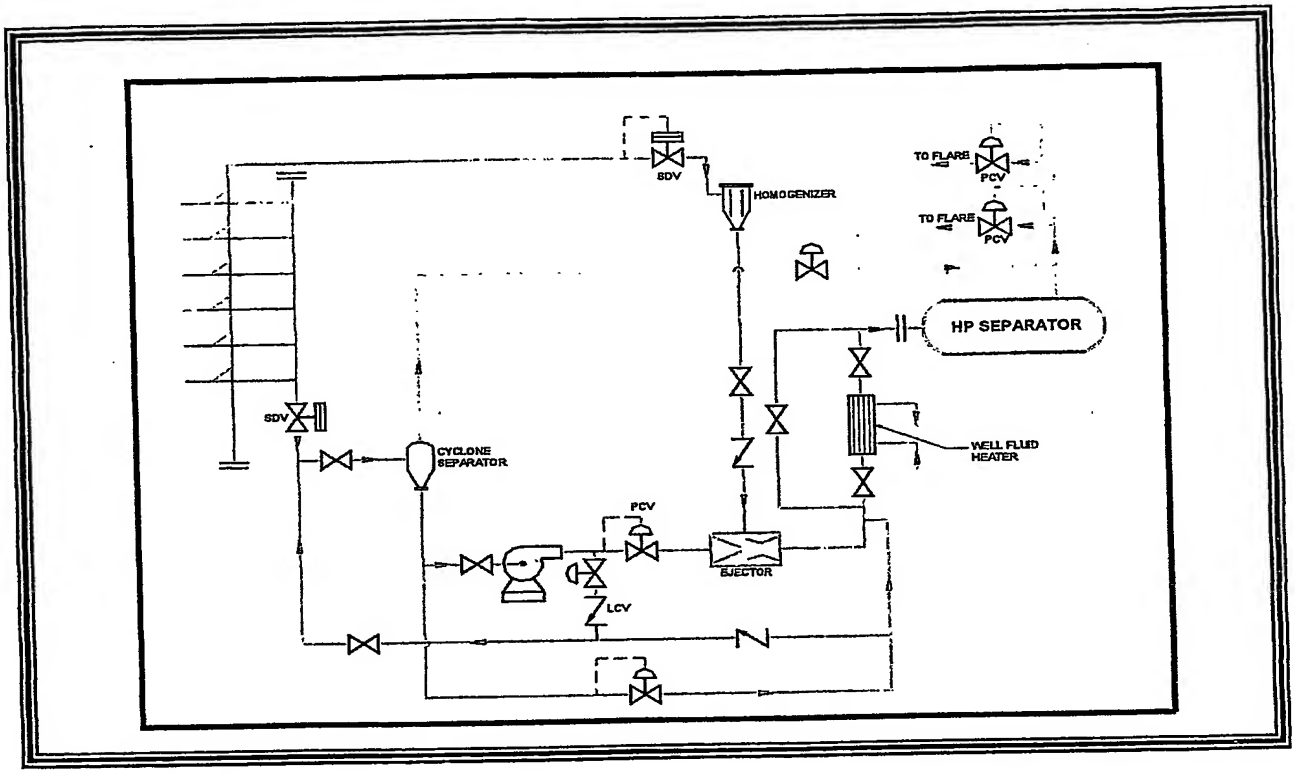


FIG - 5

(M.P. MERCHANDANI)
Attorney for Applicant

BOOSTING OF PRESSURE OF LOW PRESSURE WELLS BY MEANS OF HIGH PRESSURE WELLS FLUID

APPL. NO. 1mum/03 Total Sheet 7
Sheet no. 6

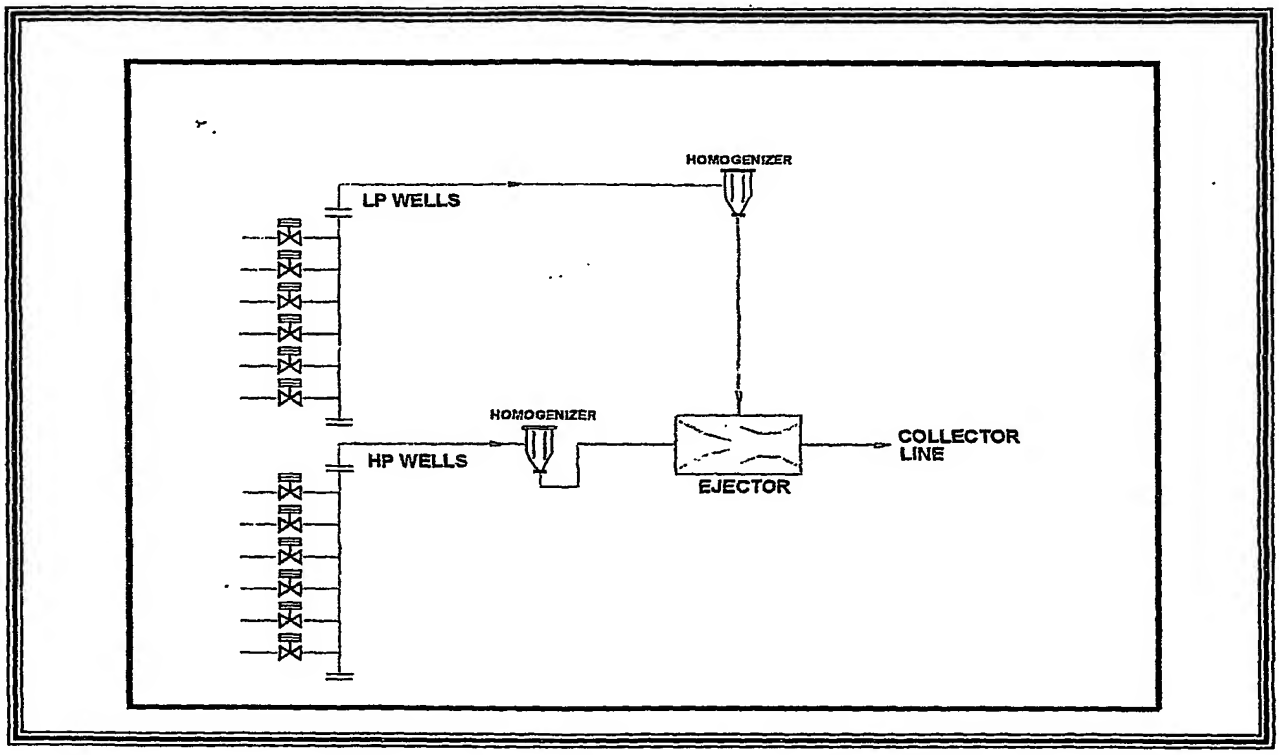


FIG - 6

M. P. MERCHANDANE
Attorney for Applicant

ACHIEVING ZERO GAS FLARING BY MEANS OF GAS TO GAS NEWLY DESIGNED EJECTORS AND LIQUID SEAL

APPL. No. 1 MUM/03

Total Sheet 7
Sheet no. 7

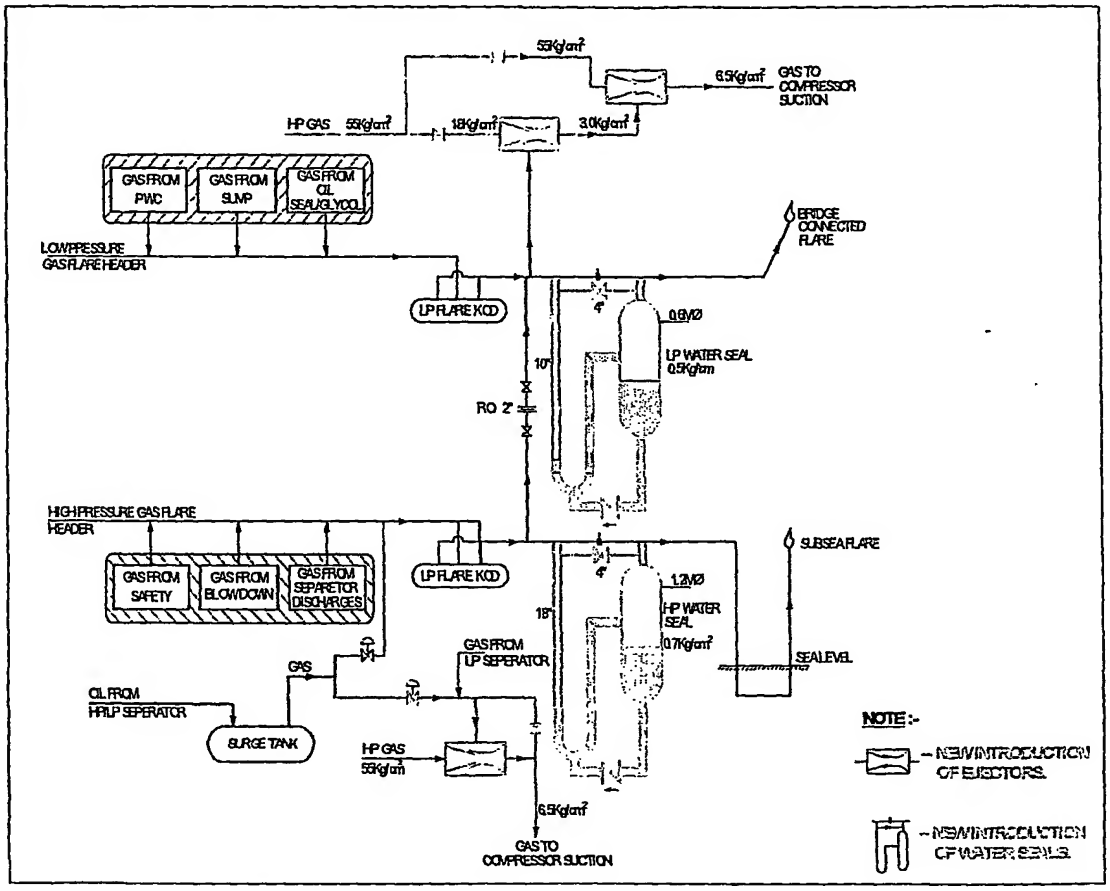


FIG.-7

(M. P. MERCHANDANI)
Attorney for the Applicant